

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re PATENT APPLICATION OF

**SUGIYAMA et al.**

Group Art Unit: 1744

Continuation of

Examiner: K. OLSEN

Appln. No.: 09/100,230

Filed: HEREWITH

Title: GAS CONCENTRATION MEASURING  
METHOD AND A COMPOSITE GAS  
SENSOR PREFERABLY USED IN THIS  
MEASUREMENT

\* \* \* \* \*

December 10, 2001

**PRELIMINARY AMENDMENT**

Hon. Commissioner of Patents  
Washington, D.C. 20231

Sir:

Prior to initial examination on the merits, please amend the above-identified patent application as follows:

**IN THE SPECIFICATION:**

Please amend the Specification as follows:

**Please amend the title of the application to read as follows:**

-- COMPOSITE GAS SENSOR --

**On the first page of the application, immediately after the title and before the section entitled "Background of the Invention," please add the following text:**

-- CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. application 09/100,230, filed June 19, 1998, which claims priority to Japanese application nos. 9-180446, filed June 20, 1997, and 9-342217, filed November 26, 1997. --

**On page 2, please replace the second full paragraph, extending from line 4 to line 6, with the following paragraph:**

Another object of the present invention is to provide a gas concentration measuring method for simultaneously measuring all of the NOx concentration, the air-fuel ratio and the oxygen concentration of the sample gas.

**On page 23, please replace the first full paragraph, extending from line 8 to line 12, with the following paragraph:**

A temperature detecting cell 50 is integrally mounted on the pump cell 21. The temperature detecting cell 50 is connected to a resistance detector 504. The temperature detecting cell 50 comprises a porous substrate 501. The sample gas pass through this porous substrate 501. A resistor 503 and a lead 502 are provided on an upper surface (i.e., outside) of the porous substrate 501.

Please see the attached Appendix for the changes made to the above paragraphs.

**IN THE DRAWINGS:**

**Please delete the informal drawings filed with the application and replace with the formal counterpart drawings enclosed herewith and numbered as sheets 1/10 - 10/10.**

**IN THE CLAIMS:**

**Please cancel claims 1-13 without prejudice or disclaimer.**

**Please enter new claims 14-17 as follows:**

14. (New) A composite gas sensor comprising:

a reference gas chamber and a sample gas chamber defined by at least one solid electrolytic substrate;

a sample gas introducing passage for introducing a sample gas into said sample gas chamber;

a first solid electrolytic substrate having an inside surface defining a wall of said sample gas chamber and an outside surface to be exposed to said sample gas before said sample gas is introduced into said sample gas chamber;

a pump cell including first and second pumping electrodes provided on said first solid electrolytic substrate, said first pumping electrode being arranged so as to be exposed to said sample gas before said sample gas is introduced into said sample gas chamber, and said second pumping electrode being arranged so as to be exposed to the sample gas introduced into said sample gas chamber via said sample gas introducing passage, so that oxygen gas residing in said sample gas chamber is discharged from said sample gas chamber by a

predetermined amount via said sample gas introducing passage when a voltage of a power source is applied between said first and second pumping electrodes;

a second solid electrolytic substrate having a surface defining a wall of said sample gas chamber and another surface defining a wall of said reference gas chamber;

an oxygen sensor cell having first and second oxygen sensing electrodes provided on said second solid electrolytic substrate to measure an oxygen concentration of said sample gas residing in said sample gas chamber, said first oxygen sensing electrode being arranged so as to be exposed to the sample gas stored in said sample gas chamber and said second oxygen sensing electrode being arranged so as to be exposed to a reference gas stored in said reference gas chamber;

a NO<sub>x</sub> sensor cell having first and second NO<sub>x</sub> sensing electrodes provided on said second solid electrolytic substrate, said first NO<sub>x</sub> sensing electrode being arranged so as to be exposed to the sample gas stored in said sample gas chamber and said second NO<sub>x</sub> sensing electrode being arranged so as to be exposed to the reference gas stored in said reference gas chamber, to measure a NO<sub>x</sub> concentration of the sample gas residing in said sample gas chamber after the discharging of oxygen gas by said pump cell is performed in response to a voltage of a power source applied between said first and second NO<sub>x</sub> electrodes;

a heater member provided for heating said first and second solid electrolytic substrates, said heater number being located far from said first solid electrolytic substrate and close to said second solid electrolytic substrate via said reference gas chamber;

a first ammeter serially connected between said power source and said first NO<sub>x</sub> sensing electrode of said NO<sub>x</sub> sensor cell to detect a limit current value representing the NO<sub>x</sub> concentration of the sample gas residing in said sample gas chamber; and

a second ammeter serially connected between said power source and said first pumping electrode of said pump cell to detect a limit current value representing the oxygen concentration of the sample gas residing in said sample gas chamber.

15. (New) The composite gas sensor of claim 14, wherein said oxygen sensor cell and said NO<sub>x</sub> sensor cell share a common reference gas electrode.

16. (New) The composite gas sensor of claim 14, wherein said sample gas introducing passage is a pinhole.

17. (New) The composite gas sensor of claim 14, wherein said first and second solid electrolytic substrates are porous, and  
wherein said sample gas introducing passage is formed by a porous layer having a porosity larger than that of said first and second solid electrolytic substrates.

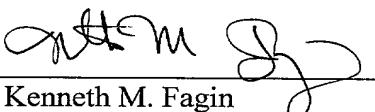
**REMARKS**

Claims 14-17 are pending in this application. Applicants have cancelled claims 1-13 without prejudice or disclaimer. Additionally, Applicants have amended the Specification and substituted new informal drawings to reflect the amendments and drawing changes made in the parent application, Apnl. No. 09/100,230, of which this application is a continuation application.

Early and favorable action on the merits is earnestly solicited.

Respectfully submitted,

PILLSBURY WINTHROP LLP

By   
Kenneth M. Fagin  
Reg. No.: 37,615  
Tel. No.: (703) 905-2066  
Fax No.: (703) 905-2500

KMF:AM

Enclosure:

Appendix (p. 7)  
Ten Sheets of Formal Drawings

**APPENDIX**

**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**IN THE SPECIFICATION:**

**The title of the application is amended as follows:**

[GAS CONCENTRATION MEASURING METHOD AND A]  
COMPOSITE GAS SENSOR [PREFERABLY USED IN THIS  
MEASUREMENT]

**On page 2, the second full paragraph is amended as follows:**

[Anther] Another object of the present invention is to provide a gas concentration measuring method for simultaneously measuring all of the NOx concentration, the air-fuel ratio and the oxygen concentration of the sample gas.

**On page 23, the first full paragraph is amended as follows:**

A temperature detecting cell 50 is integrally mounted on the pump cell 21. The temperature detecting cell 50 is connected to a resistance detector 504. The temperature detecting cell 50 comprises a porous substrate 501. The sample gas pass through this porous substrate 501. A resistor [505] 503 and a lead [501] 502 are provided on an upper surface (i.e., outside) of the porous substrate 501.